The Effect of Short-Selling on Information Arrival around Earnings Announcements: Evidence from Regulation SHO

ABSTRACT

Short-sellers assist in impounding negative news more quickly into stock prices and improve price informativeness. However, there is a lack of consistent evidence about when and how short-sellers acquire an information advantage – *i.e., private* vs. *public* channels, and incorporate such information into their trading activities. To shed light on these questions, I exploit Reg SHO to examine price informativeness before, during and after earnings announcements. I show that relative to control firms, pilot firms have greater (less) price informativeness before (during) earnings announcements, suggesting that short-sellers are informed via the private channel and that the segment of short-sellers that trade on earnings news is populated predominantly by those who acquire private information prior to earnings releases. I also find that the main results are more pronounced for a sub-sample comprised of firms with low corporate transparency, relative to a sub-sample with high corporate transparency.

Keywords: short-seller; price informativeness; Reg SHO;earnings announcements.

JEL Classifications: M40, M41, M48.

Data Availability: Data are available from the public sources cited in the text.

I. INTRODUCTION

In this study, I investigate when and how short-sellers are informed. Specifically, I exploit the quasi-natural experimental setting provided by the introduction of the Securities and Exchange Commission (SEC) Regulation SHO (Reg SHO), which significantly reduced the constraints faced by short-sellers for a subsample of U.S. firms (pilot group), and investigate whether this is associated with a change in information arrival around earnings announcements. That is, I explore whether the stock price of the pilot group reflects the upcoming earnings news in a more timely fashion resulting in less information being available during earnings announcements.

As informed investors, short-sellers assist in impounding negative news more quickly into stock prices (e.g., Diamond and Verrecchia 1987), and hence potentially improve price informativeness (e.g., Boehmer and Wu 2013; Saffi and Sigurdsson 2010). However, there is a lack of consistent evidence about when and how short-sellers acquire an information advantage, and when they incorporate such information into their trading activities (e.g., Boehmer, Jones, and Zhang 2012; Engelberg, Reed, and Ringgenberg 2012).[1] Short-sellers can be informed through private information acquisition (which I refer to as the private channel) and/or through superior information processing of public information (the public channel). If the private channel exists, then the information will be reflected in the stock price prior to its public release due to short-selling activities. On the other hand, if the public channel dominates, the information will be impounded after the public information is released. Given that the above two channels are not mutually exclusive, it is an interesting question to empirically assess the extent to which the two

[1] One stream of literature (e.g., Christophe, Ferri, and Angel 2004; Christophe, Ferri, and Hsieh 2010; Desai, Krishnamurthy, and Venkataraman 2006; Karpoff and Lou 2010) provides evidence that short-sellers can predict upcoming earnings news, financial restatements, analyst downgrades and financial misconduct. Another stream (e.g., Blau and Pinegar 2013; Drake, Rees, and Swanson 2011; Engelberg et al. 2012) instead argues that short-sellers' information advantage comes from reacting to news (e.g., earnings news and financial restatements).

channels reflect short-sellers' information acquisition. I investigate this question by examining price informativeness before, during and after earnings announcements. I focus on earnings announcements because earnings are a premier and highly visible source of firm-specific information, and investors rely on earnings more than any other measure of performance (e.g., Francis, LaFond, Olsson, and Schipper 2004; Graham, Harvey, and Rajgopal 2005).[2]

To draw a causal link between short-selling and price informativeness, I exploit an exogenous shock to short-selling activities.[3] In July 2004, the SEC adopted Rule 202T of Reg SHO, which established procedures for the SEC to temporarily suspend any short-sale price test (including the tick test for exchange-listed stocks and the bid test for Nasdaq National Market stocks) — a short-sale constraint — on short-selling in U.S. equity markets, in order for the SEC to study the effectiveness of the tests.[4] Under the Reg SHO pilot program, short-sale constraints were suspended for only a subset of (effectively) randomly selected firms (pilot firms), while those

---

[2] Beyer, Cohen, Lys, and Walther (2010) document that stock returns during management forecasts can explain firms' quarterly returns better than those during earnings announcements. In this study, I focus on earnings announcements, and not management forecasts, for two reasons. First, given that only 40 percent firms provide management forecasts during the Reg SHO period, centering on management forecasts will cause substantial data attrition. Second, given that this study is aimed at examining whether short-sellers can acquire earnings news before the announcements, a voluntary disclosure decision is not an appropriate event because short-sellers may affect corporates' voluntary disclosures and their content. Specifically, there is less of a concern regarding endogeneity with earnings announcements.

[3] Prior literature suggests that the less informativeness of a firm's stock price can potentially increase short-selling, which may give rise to a potential endogeneity concern when short-interest is an explanatory variable to examine the effect of short-selling on price informativeness. Therefore, Reg SHO provides a clean setting for this study to mitigate this reverse causality concern. For example, Sloan (1996) finds that the high accruals are associated with firms' low future returns and Richardson, Sloan, Soliman, and Tuna (2005) attribute this association to mispricing. Specifically, Richardson et al. (2005) argue that naive investors do not understand the implications of accrual reliability and earnings persistence, and they will be surprised by next period's low earnings performance, resulting in negative abnormal returns in the next period. As informed investors, short-sellers have incentives to exploit this mispricing and increase short-interest in firms with the high accruals (e.g., Curtis and Fargher 2014; Desai et al. 2006).

[4] In 1938, the NYSE adopted an uptick rule, Rule 10a-1, known as the "tick test". The rule requires that a short-sale cannot be completed if the current bid price is below the most recently traded price (plus tick). In 1994, the NASDAQ also adopted its own price test under Rule 3350, requiring a short-sale to occur at a price one penny above the current bid price if the current bid price is a downtick from the previous bid. The purpose of these tests is to prevent short-sellers from participating in market manipulation that forces prices downward.

for other firms (control firms) remained unchanged.[5] As a result, around the announcement date, short interest increased dramatically for pilot firms compared to control firms (Grullon, Michenaud, and Weston 2015), consistent with Reg SHO having a substantial effect on short-selling activities for the pilot firms. Managers also appeared sensitive to such effects on their firms. For instance, in a 2008 NYSE survey, the majority of top executives surveyed were in favour of re-instituting the price tests as soon as possible (Grullon et al. 2015). Therefore, the exogenous shock to short-sale constraints along with the randomization of treatment firms under Reg SHO provides an attractive quasi-natural experimental setting within which to examine the potential causal effect of short-selling on price informativeness around earnings announcements.

I investigate the short-selling effect via difference-in-differences (DiD) comparisons between pilot vs. control firms before and during the Reg SHO pilot program.[6] Following Ball and Shivakumar (2008), I quantify the informativeness of stock prices by using the R-squared (R^2) in a regression of securities' quarterly abnormal returns (centred on earnings announcements) on several sub-period abnormal returns.[7] The R^2 reflects the proportion of variation of quarterly returns explained by the sub-period returns, and can be interpreted as reflecting the information

[5] As per the Rule 202T's pilot program, stocks in the Russell 3000 index as of June 25, 2004 were ranked by average daily dollar volume of trade over the 1 year prior to the issuance of Reg SHO from highest to lowest for the period. Within each exchange — American Stock Exchange, New York Stock Exchange or NASDAQ — every third ranked-stock was drawn from the pool and designated into the pilot group, resulting in a pilot group comprising 986 stocks and a control group (comprising all remaining stocks in the Russell 3000 index). From May 2, 2005 to August 6, 2007, pilot stocks were exempted from short-sale price tests, and after August 2007, the SEC repealed the price test rule on short-selling for all stocks.

[6] For completeness, I also examine the difference between pilot and controls after the Reg SHO pilot program expired, and the results are discussed in the section of further analysis.

[7] Use of a multi-day pre-announcement window is appealing because it is unlikely for short-sellers to trade only one or two days before earnings announcements. For example, Kyle (1985) argues that informed traders are more likely to hide their private information by engaging in many relatively smaller trades rather than a single large trade. Therefore, a long pre-announcement interval can more likely help us fully capture the effect of short-selling on price informativeness regarding the upcoming announcement. The associated risk, on the other hand, is that information and short-selling unrelated to the upcoming news may be incorporated in the testing. Given that I have no ex-ante prediction about the period during which short-sellers trade on the upcoming news, I choose different periods from a 28-day (middle point between 2 adjacent earnings announcements) to a 5-day pre-announcement period. Given the well-documented post earnings announcement drift, I choose a symmetric post-announcement period accordingly.

content in the sub-period relative to the total information arriving and causing price movement throughout the entire quarter. I first examine the differential R^2 between pilot and control firms when the sub-period return is measured over a pre-announcement window. If short-sellers are informed via the private channel, and their trading enhances the informativeness of stock prices, pilot firms will have a larger R^2 when the sub-period return is measured over a pre-announcement window. I find evidence consistent with this prediction: the average R^2 of pilot firms is 0.02-0.06 larger than that of control firms during the Reg SHO pilot program and statistically significant, suggesting that more information arriving throughout the entire quarter is priced before earnings announcements due to short-sellers' trading based on private information.

I then consider the differential R^2 when the sub-period return is measured over an announcement window. This allows me to investigate the relative importance of the two channels of information acquisition because the observed R^2 is the net result of two opposite effects exerted by the two channels of short-selling. First, if short-sellers are informed via the public channel (through superior analysis of earnings announcements), the R^2 when the sub-period is based on the announcement window will be larger for pilot firms than for control firms. Second, if short-sellers are informed via the private channel, the R^2 will be smaller for pilot firms because earnings news is already partially priced prior to the announcements. Therefore, observing a smaller R^2 suggests a dominant role for the private channel. I find that the R^2 of pilot firms is 0.02-0.04 smaller when the sub-period return is measured *during* the announcement period. Along with the first finding where pilot firms have larger R^2 when the sub-period return is measured before announcements, this finding suggests that the segment of short-sellers that trade on earnings news is populated predominantly by those who acquire private information prior to the earnings release.

The above research methodology and empirical findings are implicitly based upon the assumption that short-selling is informative, captured by the change in the R^2. To validate this assumption, I examine the differential R^2 (pilot vs. control firm) when the sub-period return is measured over the *post-announcement* period. If the assumption is valid (i.e., short-sellers are informed), pilot firms will have a smaller R^2 when quarterly returns are regressed on the returns during the *post-announcement* period because more earnings information is already priced either before or during earnings announcements. Otherwise, if short-selling increases price noise and impedes the impounding of news into the stock price, pilot firms will have a larger R^2 because short-sellers' uninformed trading will likely impede the impounding of news into the stock price during the announcement period, and consequently delay the information to the post-announcement period. I find that pilot firms have a smaller R^2 when regressing quarterly returns on returns during the post-announcement period, and this is consistent with the implicit assumption that short-selling on average is informative.

Next, I analyse cross-sectional variation in the effect of short-selling on the information arrival around earnings announcements. Limited corporate transparency increases demand for private information to alleviate the information gap between managers and outside investors. For example, Verrecchia (1982) suggests that traders increase private information acquisition when the precision of accounting disclosure is low. I predict and find that short-sellers' private information collection is more pronounced for a sub-sample comprised of firms with low corporate transparency, relative to a sub-sample with high corporate transparency.

Although my findings are consistent with a dominant portion of short-sellers being privately informed, short-sellers can also predict upcoming earnings by processing publicly available information. I consider two types of publicly available information upon which short-sellers might trade before an upcoming earnings announcement. One is the firms' unexpected earnings surprise in previous quarters. As the prior literature suggests, firms reporting a positive/negative earnings surprise in the previous quarter are more likely to be followed by a positive/negative earnings surprise in the current quarter. Short-sellers may anticipate less/more profitability if the earnings surprise is positive/negative in the previous quarter, and the trade is based upon such a prediction. The other type of publicly available information relates to firms' growth opportunities. As prior literature suggests, short-sellers sell high growth firms because those firms provide short-sellers with greater potential profits (relative to value firms) when earnings news is unfavourable. I find that neither of these two alternatives can explain the difference in price informativeness between pilot and control firms during the Reg SHO program.

Finally, I conduct two robustness checks. First, to bolster the claim that short-sellers are informed, I examine the post-earnings announcement drift (PEAD) for pilot firms, by implementing the methodology developed in Ball and Shivakumar (2008). This approach provides an opportunity to examine the effect of short-selling on price efficiency without assuming market-efficiency or a model for computing earnings news. Specifically, I compare the coefficient of sub-period abnormal returns in the regression of securities' quarterly abnormal returns with unity where larger/smaller than unity suggests an under/over-reaction in the announcement window. I find that during the Reg SHO period the coefficient for pilot firms is insignificantly different from one at conventional levels, suggesting neither under-reaction (i.e. PEAD) nor over-reaction for pilot firms. Second, I examine the difference in the R^2 after the expiration of the Reg SHO program and document a diminishing effect of short-selling in the year immediately after Reg SHO expired.

My study contributes to the related literature in several ways. First, my findings complement prior research on the sources of short-sellers' information advantage. Christophe et al. (2004) find that short-selling is negatively related to returns during earnings announcements, suggesting that short-sellers have private information regarding upcoming earnings news. In contrast, Blau and Pinegar (2013) find short-sellers are not incrementally informed before earnings announcements, after controlling for their ability to predict future returns during the non-announcement period as documented by Diether, Lee, and Werner (2009a), suggesting that short-sellers have no private information related to earnings. By employing an exogenous shock to short-selling constraints, I document a causal link between short-selling and price informativeness before earnings announcements, providing robust evidence consistent with short-sellers possessing private information about upcoming earnings news.

Second, I extend the literature by demonstrating that the segment of short-sellers that trades on earnings news is predominantly populated by those who acquire private information before an earnings release. Though prior literature (e.g., Christophe et al. 2004; Christophe et al. 2010; Engelberg et al. 2012) documents evidence regarding whether short-sellers' informational advantage comes from a private or public channel, to my knowledge no study examines the relative importance of those two channels. Given that they are non-exclusive, I investigate the two channels together and find more (less) information throughout a quarter is concentrated during the pre-announcement (announcement) period, suggesting that the private channel dominates the public channel.

Finally, I provide novel evidence that opaque firms' information environment increases activities of investors' private information collection to fill the information asymmetry gap between managers and investors. For example, Barth, Kasznik, and McNichols (2001) document that analysts are more likely to follow firms with high information asymmetry (e.g., high levels of intangible assets) because of higher demand from investors for information. I find that limited corporate transparency provides short-sellers (informed investors) greater informational advantage over other investors.

The remainder of the paper is organized as follows. In section II, I describe in more detail the related literature and my research questions. Sections III and IV describe the sample and my research design, while section V presents my empirical results and section VI concludes.

II. RELATED LITERATURE AND RESEARCH QUESTIONS

In this section, I provide some institutional background to Reg SHO, review related literature and propose my research questions.

The Background to Reg SHO

Rule 202T of Reg SHO was adopted by the SEC in July 2004 to establish procedures enabling it to temporarily suspend particular short-sale price tests for a subset of firms (pilot firms), without affecting the short-sale constraints of other firms (control firms). On June 25, 2004, Rule 202T's pilot program ranked stocks in the Russell 3000 index from highest to lowest by their average daily dollar volume of trade spread across a period of one year before the implementation of Reg SHO. Every third-ranked stock from the American Stock Exchange (NYSE American), New York Stock Exchange (NYSE), and NASDAQ respectively, totalling 986 stocks, was assigned into a pilot group, while the remaining Russell 3000 index stocks went into a control group.

While pilot stocks were exempted from short-sale price tests between May 2, 2005 and July 6, 2007, the price test rule on short-selling for all stocks was revoked by the SEC after August 2007, leading to large scale disappointment across managers and exchanges. An NYSE survey in 2008 revealed that 85percent of top managers favoured reintroduction of the price tests on an immediate basis (Grullon et al. 2015). The SEC was partly blamed for the 2007-08 financial crisis by several stakeholders, including law firms, members of congress and journalists, because of increased short-selling. On February 24, 2010, the SEC relented under the pressure, and restored a revised upward trend rule that triggers price tests when a firm's stock price drops by 10percent or more compared to the previous closing price.

Impact of Reg SHO on Information Arrival around Earnings Announcements

Prior evidence suggests that short-sellers are informed traders; future negative returns are predicted by high short interest or short volumes (e.g., Asquith, Pathak, and Ritter 2005; Senchack and Starks 1993), and short-sellers' trading can improve price efficiency (e.g., Boehmer and Wu 2013; Saffi and Sigurdsson 2010). The predictability of future returns indicates that short-sellers have an information advantage over other investors. Prior research suggests that this information advantage may come from two sources. First, short-sellers may become informed via a private channel, where information is not publicly available. This argument is supported by evidence that short-selling activities increase before negative earnings, analyst downgrades or revelation of firms' financial misconduct (e.g., Christophe et al. 2004; Christophe et al. 2010; Karpoff and Lou 2010). Second, they may also become informed via a public channel - through more efficient processing of publicly available information. For example, by combining a large archive of all corporate news events with daily short-selling, Engelberg et al. (2012) comprehensively examine the relation between short-selling and news events. They find that short-selling increases significantly after news announcements, and that the well-documented negative correlation between short-selling and negative returns is twice as large on news days, and four times as large on negative news days.

In summary, the private information channel suggests that short-sellers bring information to the market prior to public information arrival, while the public information channel suggests that short-sellers impound information into stock price when such information is publicly announced. I exploit this difference to infer when and how short-sellers are informed by examining price informativeness pre-, during and post-earnings announcements. Specifically, to the extent that Reg SHO significantly reduces the cost of short-selling in pilot firms, I examine the differences in price informativeness between pilot and control firms around earnings announcements. An observation that pilot firms are more price informative than control firms before earnings announcements implies the short-sellers are informed via the private channel. Therefore, I formalize the first research question as follows:

R1: During the implementation of Reg SHO, are pilot firms more price informative pre-earnings announcements, compared to control firms?

Impounding private information prior to earnings announcements results in less (new) information being available when earnings are announced.[8] On the other hand, if short-sellers possess superior ability in processing public earnings news, they may also impound information more quickly during the earnings window. Because the private and public channels are not exclusive, the observed differential price informativeness at earnings announcements represent the net effect of the two channels, and less informativeness implies dominance of the private channel. Therefore, I formalize the second research question as follows.

[8] The implicit assumption is that total earnings-related information is constant and short-sellers have knowledge, at least in part, of upcoming earnings. That is, firms do not alter the information provided in the earnings reports in response to the presence of short-sellers, and short-sellers' trading pre-earnings announcements increases price informativeness. Alternatively, the higher price informativeness could also reflect short-sellers' knowledge of some negative news beyond the upcoming earnings (e.g., earnings restatements), which has no effect on price informativeness during earnings announcements. To disentangle the alternatives, I employ a sample comprising firms with good earnings news. The untabulated results show no difference in informativeness between pilot and control firms before earnings announcements. This suggests that the motive for short-selling is more likely related to the upcoming earnings. In addition, examining price informativeness (measured by R^2) during earnings announcements can provide some insights because an observation of lower price informativeness is consistent with short-sellers being informative with respect to upcoming earnings.

R2: During the implementation of Reg SHO, are pilot firms less price informative during earnings announcements, relative to control firms?

The above two research questions are based upon the assumption that short-sellers are informed investors, which implies reduced information post-earnings announcements regardless of the information channel – private or public. That is, pilot firms have less information in their price post-earnings announcements, compared to control firms. In contrast, if short-sellers are mainly uninformed investors who just trade in the direction of earnings news and increase stock price volatility when earnings are announced, pilot firms will have more information in their price during post-announcement period because informed traders would correct the effects of noisy short-selling at the announcements. Therefore, examining price informativeness post-earnings announcements can assist in answering the question: Are short-sellers informed? This leads to my third research question as follows:

R3: During the implementation of Reg SHO, are pilot firms more price informative post-earnings announcements in comparison to control firms?

III. SAMPLE SELECTION

I begin with the Russell index as of June 2004. On July 28, 2004, the SEC announced that out of the Russell 3000, 986 stocks would trade without any price test restrictions applied to short-sales during the term of the pilot program.[9] Following the SEC requirements, I exclude stocks that are not listed on the NYSE, NYSE American or Nasdaq, and also those that went private or had spin-offs after April 30, 2004. As a result, I identify 986 pilot firm stocks (the pilot group)

[9] Details of the pilot list are available at http://www.sec.gov/rules/other/34-50104.htm.

according to the published list of the SEC's pilot order, and 1,986 non-pilot firm stocks (the control group).[10]

I obtained financial statement data from COMPUSTAT and stock returns from CRSP. Additionally, I obtained analyst following and management earnings forecast information from I/B/E/S to investigate the cross-sectional variation of the findings in firms' information environment. I define the Reg SHO pilot period (*durSHO*) as the period from May 2, 2005 to July 6, 2007, when the pilot program was in place. Furthermore, I examine whether the effect of Reg SHO on price efficiency around earnings announcements diminishes after August 2007, when the uptick rule was also suspended for the control group. I choose the post-SHO implementation period (*postSHO*) as the period from August 2007 to July 2008.[11]

Following related literature (e.g., Diether, Lee, and Werner 2009b; Grullon et al. 2015), I exclude firms with a stock price of less than $1 from the sample. I also exclude firm-quarters with less than 30 days of stock returns pre- and post-earnings announcements. Additionally, I include only bad earnings news in the sample, computed as the actual EPS (from I/B/E/S) minus the mean analysts' earnings forecasts during the 30 days before earnings announcements (from I/B/E/S detailed file).[12] [13]

[10] The total number of firms in my sample at this step is 2,972, comparable to the 2,952 identified by Fang, Huang, and Karpoff (2016).
[11] I do not include the second half of post-Reg SHO to avoid the effect of the global financial crisis (2008-2009).
[12] Relative to random-walk forecasts (e.g., the earnings from the same quarter of the previous year), the analyst forecast consensus is timely and comprehensive, and has been used widely in empirical research as a benchmark for unobservable market earnings expectations because analysts have incentives to quickly impound value-relevant predictions into their forecasts. See Bhattacharya, Black, Christensen, and Mergenthaler (2007).
[13] To improve the power of my tests, I focus on bad earnings news because prior studies document an increase in short-selling prior to various firms' negative news (Christophe et al. 2004). The bad earnings news is defined as earnings news where the actual earnings are lower than analyst consensus.

Finally, to exclude the confounding effect of management forecasts on the earnings news, I exclude earnings announcements bundled with management forecasts.[14] The final sample covers the *durSHO* and is comprised of 1858 (3861) firm-quarters and 624 (1278) unique firms in pilot (control), respectively.

IV. RESEARCH DESIGN AND SUMMARY STATISTICS

I employ a difference-in-differences approach, using Reg SHO as the quasi-natural experiment, to identify the causal effect of short-selling on price informativeness around earnings announcements. Specifically, I compare price informativeness pre-, during and post-earnings announcements between pilot firms and control firms before, during and after the pilot program.

Measurement of Price Informativeness

To examine the research questions, I build on the approach used by Ball and Shivakumar (2008). They quantify the value-relevant new information in earnings announcements by estimating the proportion of variation in annual stock returns associated with four "announcement window" quarterly earnings-announcements returns.[15] In this study, I adapt the Ball-Shivakumar framework to quarterly returns and three associated sub-period returns – pre-, during, and post-earnings announcements. Specifically, I regress quarterly returns – RET_i(*quarterly*) on returns in

---

[14]Following Rogers and Van Buskirk (2013), an earnings announcement is treated as bundled with management earnings forecasts if a management forecast is provided within 3 days of an earnings announcement. I analyze the earnings announcements bundled with management forecast separately and the results are discussed in the footnote 21.

[15] Ball and Shivakumar (2008) employ the R-squared from a regression of annual stock returns on four quarterly earnings announcements returns as a measure of new information in earnings announcements. There are two advantages to this approach. First, there is no need to estimate an earnings surprise that requires an estimated earnings expectation, which reduces errors in measuring expectation. Second, this approach does not assume market efficiency. It allows price revisions during earnings announcements window to be correlated with price revisions outside the window. Therefore, it is less susceptible to underestimating the information in the earnings announcements. Indeed, the method provides a test of market efficiency. If the coefficient on the earnings announcements returns is greater (less) than one, it suggests an initial market under (over) reaction to earnings announcements. For instance, Ball and Shivakumar (2008) document the coefficients on the four quarterly earnings announcements are on average all greater than one, consistent with the post-earnings-announcements drift (PEAD) phenomenon.

sub-period returns – $RET_i(pre\_announce)$, $RET_i(dur\_announce)$ and $RET_i(post\_announce)$ around earnings-announcement windows, respectively:

$$RET(quarterly)_t = \beta_0 + \beta_1 RET(sub\_period)_t + \varepsilon \quad (1)$$

Where $RET(sub\_period)_t$ is $RET(pre\_announce)$, $RET_i(dur\_announce)$ or $RET_i(post\_announce)$ to investigate research questions 1, 2 or 3 respectively. The adjusted R^2 from the above regression measures the proportion of quarterly returns variation associated with each sub-period. In the following subsections, I discuss issues relating to empirical implementation and interpretation of this approach.

Returns Measurement

In the main tests, quarterly returns are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -28 to +28, relative to earnings-announcement date, day 0. Earnings-announcement returns are buy-and-hold abnormal returns over days -1 to +1. Returns pre-/post-earnings announcements are buy-and-hold abnormal returns over days -28 to -2, and +2 to +28, respectively. Panel A of Figure 1 illustrates this design.[16]

In further analysis, to examine how short-selling affects PEAD, I regress the quarterly returns $RET_i(quarterly)$ on returns at announcements RET_i $(dur\_announce)$, where RET_i $(quarterly)$ is the buy-and-hold abnormal return over days -1 to +31, relative to the earnings-announcement date, day 0. Earnings-announcement returns are still buy-and-hold abnormal returns over days -1 to +1. This modified research design helps me to investigate more accurately

[16] To mitigate the concern of correlation of LHS variable (i.e. quarterly stock returns), I exclude firm-quarters with less than 57 trading days between two consecutive earnings announcements dates, which results in an approximately 29 percent observation attrition. Another way to resolve the correlation issue is to shorten the 57-day window. I also employ this approach in the study. However, the above approaches cannot eliminate all source of correlation, such as the correlation simply due to common industry membership.

the extent to which information during earnings-announcement drifts to the post-announcement period. Panel B of Figure 1 illustrates this design.

[Insert Figure 1 about here]

Interpretation of R^2

I estimate model (1) for pilot and control firms separately, and the difference in estimated R^2 captures the effect of short-selling on price informativeness around earnings announcements. For example, I regress RET_i(*quarterly*) on RET_i(*pre_announce*) for pilot and control firms during Reg SHO respectively. A positive R^2_{DIFF} (i.e. R^2_{pilot} - $R^2_{control} > 0$) suggests more information is impounded into the pilot firms' prices pre-earnings announcements. A similar method and interpretation is applied when I regress RET_i(*quarterly*) on RET_i(*dur_announce*) or RET_i(*post_announce*). Since I am interested in examining whether short-sellers possess private information relating to earnings, a long event-window (i.e., days -28 to +28, relative to earnings-announcement date, day0) may incorporate other information sources apart from upcoming earnings, and potentially dampens the inferences. Therefore, I systematically narrow the window size for RET_i(*quarterly*) and the associated RET_i(*pre_announce*) and RET_i(*post_announce*) to counter this possibility.[17] The window width starts at 28 days, and is narrowed by 3-day increments until 4 days pre-/post-earnings announcements.[18]

[17] Adjusting the event-window can provide two additional benefits. First, it allows me to examine the robustness of the results to the window period. Second, the changing window period can provide additional insight regarding when information is impounded into price by short-sellers. For example, if short-sellers impound information into price on average 28 days pre-earnings announcements, I will find weaker or no increase of price informativeness pre-earnings announcements when I use 25 days or shorter windows.

[18] Nevertheless, narrowing the window comes with its own costs. One cost is that a portion of earnings news might be impounded into price by short-sellers beyond the scope of the window. Hence the inference from the results with a narrower window, e.g., [-16, +16], should consider the results with a wider window, e.g., [-28, +28], to avoid misinterpretation. An example is provided and discussed in the results section.

Statistical Test on R^2_{DIFF}

Following Ball and Shivakumar (2008), I interpret R^2_{DIFF} between pilot and control firms during Reg SHO as reflecting the effect of short-selling on price informativeness around earnings announcements. Due to the small sample size for R^2_{DIFF}, the normal distribution assumption underlying student t tests might be inappropriate. Specifically, there are only eight quarters in the Reg SHO period, resulting in only eight estimated R^2_{DIFF} values. To overcome this potential problem, I test the statistical significance of R^2_{DIFF} during the pilot period using a test based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period.[19] Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between the pilot and control firms. By repeating this procedure a thousand times, I obtain an empirical distribution of R^2_{DIFF} (with 1,000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between the pilot and control firms. I use the empirical distribution to determine the significance level of the observed R^2_{DIFF} from the pilot period.

Descriptive Statistics

In Table 1, I compare the primary research variables between pilot and control firms pre-Reg SHO announcement. Because the pilot firms are chosen by (effectively) random selection from Russell 3000 index firms, there should be no systematic difference between these two groups pre-SHO. In general, pilot firms do not significantly differ from control firms in the pre-Reg SHO period for returns (*RET*(*quarterly*), RET_i(*pre_announce*), RET_i(*dur_announce*) and RET_i(*post_announce*)), firm size (SIZE) and growth opportunities (MTB). Furthermore, the mean

[19] Barth, Landsman, and Lang (2008) employ a similar procedure to test statistical significance in their research setting.

abnormal returns (adjusted by value-weighted market returns) during the three-day window at earnings announcements is 0.4 percent (0.004), which is consistent with the results in Ball and Shivakumar (2008). However, pilot firms have a higher average ROA of 0.4 percent (i.e., 0.5 percent vs. 0.1 percent), significant at the 1 percent level. I investigate this issue and find that the difference is weaker if I use the data from one year prior to the Reg SHO announcement, which is the time period used by the SEC to choose the pilot firms.

[Insert Table 1 about here]

V. RESULTS

I organise the discussion of my empirical results into three subsections. In the first section, I provide evidence on an association between short-selling and price informativeness in each sub-period around earnings announcements. In the second section, I examine the relation between the corporate information environment and the effect of short-selling on price informativeness. Finally, in the third section, I provide further evidence consistent with short-sellers possessing private information relating to upcoming earnings news.

The Effect of Short-selling on Price Informativeness

Pre-earnings Announcements

In this section, I examine whether short-selling is associated with change in price informativeness pre-earnings announcements. Row 1 of Table 2 reports the R^2_{DIFF} from estimating equation (1) for pilot and control firms when the right-hand-side (RHS) return-window is pre-earnings announcements – $RET_i(pre\_announce)$ during Reg SHO. When the quarterly returns are computed at days -28 to +28, namely [-28, +28], the R^2 from the regression for control (pilot) firms is 0.38 (0.45), indicating that control (pilot) firms' stock returns pre-earnings announcements incorporate 38 percent (45 percent) of total quarterly information during Reg SHO. The R^2_{DIFF}

(i.e., 0.06) falls into the 99 percent top tail of the empirical distribution generated from the pre-Reg SHO period, indicating that short-selling significantly increases pilot firms' price informativeness pre-earnings announcements. Furthermore, this difference is of economic significance because the pilot firms increased their R^2 by 13 percent (0.06/0.45) on average during the Reg SHO.

Varying the return-window from [-28, +28] to [-4, +4], relative to earnings announcements (day 0), I obtain a series of R^2_{DIFF}. All are statistically significant at conventional levels (from the right most column to the left most column in Row 1), indicating that short-sellers impound information into price consistently in the days leading up to earnings announcements.

Regarding R1 (*During the implementation of Reg SHO, are pilot firms more price informative prior to earnings announcements, compared to control firms?*) the results show that pilot firms' price informativeness is consistently greater prior to earnings announcements, compared to that of control firms, strongly consistent with the notion that short-sellers are informed via private information channels.

[Insert Table 2 about here]

During earnings Announcements

I next investigate the relation between short-selling and price informativeness during earnings announcements. Row 2 of Table 2 reports the R^2_{DIFF} from estimating equation (1) for pilot and control firms when the RHS return-window is during earnings announcements – RET_i(*dur_announce*) during Reg SHO. When quarterly returns are measured at [-28, +28], the R^2_{DIFF} (i.e., -0.03) is significant at the 1 percent level (one-tailed), suggesting that pilot firms have significantly less information during earnings announcements. Given that this R^2_{DIFF} reflects both short-sellers pricing in information prior to announcements and those reacting to announcements, the negative value suggests a dominance of short-sellers possessing private information.

Adjusting the quarterly return-window from [-28, +28] to [-7, +7], the R^2_{DIFF} is consistently and significantly negative at conventional levels. This provides a positive answer to R2 (*During the implementation of Reg SHO, are pilot firms less price informative during earnings announcements, relative to control firms?*), and hence suggests a dominant role of the private channel over the public channel for short-sellers in gathering information.

Post-earnings Announcements

Finally, I investigate the association between short-selling and the information content of stock prices during the post-announcement period. Row 3 of Table 2 reports the R^2_{DIFF} from model (1) for pilot and control firms, when the RHS return-window is measured during the post-announcement period – RET_i(*post_announce*). The R^2_{DIFF} is -0.03 (significant at 10 percent level) when quarterly returns are measured at [-28, +28], and consistently and significantly negative at conventional levels for other event-windows. This indicates that control firms' prices reflect more value-related information during the post-announcement period than pilot firms' prices, and is consistent with the notion of short-sellers being informed traders. The negative R^2_{DIFF} might reflect either timely (i.e., pre- and/or during earnings announcements) or delayed price-in of information (i.e., beyond 28 days after earnings announcements). I argue that the former is more likely to occur for two reasons. First, the results in Row 1 provide strong evidence that short-sellers privately collect earnings information, and hence reduce the amount of information available during/post-earnings announcements. Second, if the latter was the primary factor, the consistently negative R^2_{DIFF} with various event-windows (from [-4, +4] to [-28, +28]) would suggest that the information is not shifted smoothly along with the days, but directly moved beyond

+28 days, which is less likely to occur.[20] To further bolster this claim, I modify the research design to specifically investigate the PEAD. The results are supportive and are discussed in detail below in the section on further analysis.

In sum, the results from Row 3 provide a negative answer to R3 (*Are pilot firms more price informative post-earnings announcements in comparison to control firms?*) The negative answer, combined with the results from Rows 1 and 2, demonstrates that short-sellers are informed regarding upcoming public earnings news, and that they increase price informativeness in a more timely fashion.[21]

Corporate Information Transparency and The Effects of Short-selling on Price Informativeness

Prior research predicts a higher demand for private information acquisition when the precision of accounting disclosure is lower (e.g., Verrecchia 1982). This literature argues that firms with limited corporate information transparency have more information asymmetry between managers and investors, and more inherent uncertainty about firm value than other firms, which suggests that stock prices of those firms will less precisely reflect their fundamentals. Accordingly, such lower price informativeness suggests opportunities exist for profitable private information acquisition activities by investors (e.g. short-sellers). Therefore, I expect that the

[20] This is less likely to occur unless there is an event 31 days after earnings announcement attracting all short-sellers' trading.

[21] This paper is to examine the extent to which short-sellers can access information relating to earnings in advance of its scheduled announcement. Management forecasts is a voluntary disclosure and not a scheduled event, which makes investors have less incentives to collected information relating to management forecasts. Therefore, the bundled management forecast will confound the inference that short-sellers' collection of private information before the earnings announcement. Nevertheless, to complete the analysis, I analyse the bundled management forecasts in a separate test. The untabulated results show that pilot firms have a significantly larger R^2 than control firms during the announcement window and no difference during the pre-earnings announcements. The different result is consistent with the results from Clinch, Li, and Zhang (2015) that suggest that pilot firms increase voluntary disclosure of management forecasts. So, the increased price informativeness during earning announcements could be reflecting this for the bundled announcements.

increase in price efficiency for pilot firms pre-earnings announcements (relative to control firms) will be more pronounced for firms with a limited (or less transparent) corporate information environment.

Prior literature documents a stronger market reaction to earnings announcements for small firms than for large ones due to the limited availability of alternative sources of information before release of the earnings (e.g., Atiase 1985). Given short-sellers can have information advantage by processing public information, the limited corporate information environment provides short-sellers greater opportunity to process the earnings during announcements and hence to accelerate information that otherwise would not get into price until the post period. Therefore, for less transparent firms the net effect of short-selling on price informativeness during announcements could be either negative (reflecting dominance of private channel) or zero (reflecting equal importance of public and private channels).

To investigate the association between corporate transparency and the effects of short-selling on price informativeness, I examine cross-sectional variation in corporate transparency proxied by three measures: (1) Management guidance – whether a firm has provided management forecasts prior to earnings announcements. A firm is viewed as less transparent if it does not provide earnings forecasts. (2) Earnings transparency[22] – whether a firm's earnings are impounded into contemporaneous stock price in a more timely manner. (3) The number of analysts.

Management Forecasts

Firms' management forecasts can reduce short-sellers' incentives to collect earnings-related information privately. Therefore, I predict that the result that pilot firms' prices are more informative prior to earnings announcements than those of control firms will be concentrated in

[22] This proxy is developed in Barth, Konchitchki, and Landsman (2013).

firms without management forecasts. To test this prediction, I partition the sample into two sub-samples: firms providing at least one earnings forecast pre-earnings announcements, and those providing no forecast. I predict that the earnings results will be more pronounced for firms without management forecasts.

Table 3 reports the R^2_{DIFF} from estimating model (1) for pilot and control firms without/with management forecasts (Panels A/B) during Reg SHO. In Panel A, when *RET*(*quarterly*) is measured at days [-28, +28] (rightmost column), and the RHS return-window is RET_i(*pre_announce*) (Row 1), the R^2_{DIFF} (0.07) is significant at the 1 percent level, suggesting that stock prices of pilot firms are more informative pre-earnings announcements. When the RHS return-window is the during-announcement or post-announcement period (Rows 2 and 3), the R^2_{DIFF} is -0.03 and -0.04, respectively (both significant at the conventional levels), suggesting that pilot firms have less information during and post-earning announcement periods. This is consistent with the claim that short-sellers possess and trade on private information related to upcoming earnings, and hence reduce value-related information during and post-earnings announcement periods. When varying the *RET*(*quarterly*) window from [-28, +28] to [-4, +4], there is a consistent pattern in the R^2_{DIFF}, suggesting that short-sellers are informed during all the days leading to earnings announcements.

Row 1 in Table 3, Panel B reports the R^2_{DIFF} when the RHS return-window is RET_i(*pre_announce*) for firms who have issued at least one management forecast. R^2_{DIFF} is in general not statistically significant, suggesting that pilot firms have similar levels of price informativeness to control firms pre-earnings announcements. Interestingly, when *RET*(*quarterly*) is measured at days [-28, +28] / [-25, +25], the difference in R^2_{DIFF} is 0.09/0.1 (both significant at the 1 percent level). This suggests that the pilot firms' prices are more informative pre-earnings announcement, inconsistent with the transparency hypothesis – no difference in R^2 for firms with greater information transparency. [23]

Row 2 in Panel B reports the R^2_{DIFF} when the RHS return-window is *RET$_i$*(*dur_announce*). The R^2_{DIFF} is -0.09 (significant at 1 percent level) when *RET$_i$*(*quarterly*) window is [-19, +19], and this significant R^2_{DIFF} is robust to other windows of *RET$_i$*(*quarterly*). Row 3 reports the R^2_{DIFF} when the RHS return-window is *RET$_i$*(*post_announce*). The R^2_{DIFF} is negative and significant at conventional levels in some cases, providing some evidence that short-sellers are on average informed traders. In general, there is less consistent evidence of R^2_{DIFF} across the different return windows related to the transparency hypothesis for panel B firms than for panel A firms, but it is not clear cut.

[Insert Table 3 about here]

Earnings Transparency

The earnings of transparent firms more precisely reflect the respective firms' underlying economic conditions. I employ a measure of transparency developed in Barth et al. (2013), based on the explanatory power of stock returns-earnings relation, i.e., to what extent a firm's stock price reflects its earnings. A unique feature of this measure is that it allows intertemporal and cross-sectional (industry and non-industry) variation in the earnings transparency measure. The measure involves a two-step procedure. In step 1, I regress firms' annual returns on earnings and change in earnings, grouped by industry-year, which allows industry variation in the measure, and save the first R^2. In step 2, I construct a quartile portfolio based upon the residuals from Step 1, re-estimate

[23] The observed significant difference in R^2 for the two largest windows may be due to more earnings guidance for pilot firms. First, Clinch et al. (2015) documents that pilot firms are more likely to disclose bad news management forecasts, and therefore impound negative news in a more timely fashion. Second, Clinch et al. (2015) finds that the early-disclosed bad news are not pre-announcement warnings (i.e., management forecasts issued after the fiscal quarter end and before actual earnings announcements), which is consistent with the findings in panel B – no difference in R^2_{DIFF} when the return-window covers days closer to earnings announcements.

the regression model within each portfolio annually, and save the second R^2. The sum of the two R^2 is the transparency measure. I then partition the full sample into two groups based on the firms' transparency measures relative to the median, and predict that the main findings will be more pronounced in firms with less transparency.

Panel A in Table 4 reports the R^2_{DIFF} for firms with less earnings transparency. Row 1 reports the R^2_{DIFF} when the RHS return-window is RET_i(*pre_announce*). The R^2_{DIFF} is 0.08 (significant at 1 percent level) when the window of RET_i(*quarterly*) is [-28, +28], and it is consistently and statistically significant with most other windows of RET_i(*quarterly*). This is consistent with short-sellers possessing private information. Row 2 reports the R^2_{DIFF} when the RHS return-window is RET_i(*dur_announce*). The R^2_{DIFF} is in general statistically insignificant, which might reflect equal importance of two channels for less-earnings-transparent firms. Row 3 reports the R^2_{DIFF} when RHS return-window is RET_i(*post_announce*). The R^2_{DIFF} is significantly negative at conventional levels with all windows of RET_i(*quarterly*) (except [-28, +28]), consistent with informed short-sellers.

Panel B in Table 4 reports R^2_{DIFF} for firms with greater earnings transparency. In general, the findings suggest no difference in price informativeness between pilot and control firms around earnings announcements.

[Insert Table 4 about here]

The Number of Analysts

I partitioned the sample into two sub-samples based on the number of analysts following a firm relative to the median. I predict that prior to earnings announcements, the difference in price informativeness between pilot and control groups is more pronounced in firms with lower analyst coverage.

Panel A in Table 5 reports the R^2_{DIFF} from the estimating model (1) for pilot and control firms with lower analyst coverage during Reg SHO. Similar to the findings for the two other proxies for information transparency, the observation that pilot firms are more informative pre-earnings announcements occurs mainly in firms with a lower analyst following, which is suggested by the significantly positive R^2_{DIFF} in row 1 Panel A (0.05-0.09 significant at the conventional levels). Row 2 reports the R^2_{DIFF} when the RHS return-window is RET_i(*dur_announce*). The R^2_{DIFF} is in general insignificant, suggesting that pilot and control firms have similar information content during announcements. This might reflect the equal importance of private and public channels for short-sellers for firms with a lower analyst following have larger earnings news during announcements. Finally, Row 3 reports the R^2_{DIFF} when the RHS return-window is RET_i(*post_announce*). The R^2_{DIFF} is significantly negative in most cases, consistent with short-sellers being informed.

Row 1 in Panel B reports the R^2_{DIFF} when the RHS return-window is RET_i(*pre_announce*) for firms with greater analyst following. The R^2_{DIFF} is significantly positive when the window of RET_i(*quarterly*) is [-16, +16], [-19, +19], [-25, +25] and [-28, +28]. Row 2 reports the R^2_{DIFF} when the RHS return-window is RET_i(*dur_announce*). The R^2_{DIFF} is in general statistically insignificant, except in some cases that might be corresponding to the increase in earnings informativeness pre-earnings announcements. Finally, Row 3 reports the R^2_{DIFF} when the RHS return-window is RET_i(*post_announce*). The R^2_{DIFF} is statistically significant and negative in some cases, consistent with short-sellers being informed.

In sum, short-sellers are more likely to collect private information when corporate transparency is limited. Additionally, the dominant role of the private channel is dampened -- no difference in R^2 during earnings announcements for firms with lower analyst coverage and less earnings transparency. In contrast, for firms with greater information transparency (proxied by earnings transparency), there is no evidence for the private information collection and superior ability in public information processing. Although there is some evidence for firms with greater information transparency (proxied by the issue of management forecasts or analyst coverage), R^2_{DIFF} across different return windows is less consistent and clear as in Table 2.

[Insert Table 5 about here]

Alternative Information Sources for Short-sellers

It is possible that the increase in pilot firms' price informativeness before earnings announcements is attributable to publicly available (rather than private) information upon which short-sellers might trade before upcoming earnings announcements. In my research design, I mitigate this concern by restricting RET_i(quarterly) to be measured over the [-28, +28] window, relative to earnings announcements, to dampen the effect of prior-quarter earnings. Nevertheless, this possibility cannot completely be ruled out. In this section, I examine two types of publicly available information sources potentially employed by short-sellers.

Prior-quarter earnings surprise

Prior studies (e.g., Joy, Litzenberger, and McEnally 1977; Latane and Jones 1979) document that a post earnings announcement drift (PEAD) exists in quarterly earnings announcements and can be exploited by forming portfolios based upon unexpected earnings (UE). In addition, Bernard and Thomas (1990) examine the possible reason for the anomaly, and conclude that it is more likely market mispricing than a risk factor. The implication of this relation to short-sellers is that firms reporting a positive/negative earnings surprise in the previous quarter are more likely to be followed by a positive/negative earnings surprise in the current quarter.

Therefore, short-sellers may anticipate less/more profitability if earnings surprise is positive/negative in the previous quarter.

To investigate this possibility, I partitioned the sample into two sub-samples based upon prior-quarter UE relative to zero: firm-quarters with positive prior-quarter UE and those with negative prior-quarter UE. If short-sellers trade on prior-quarter UE, they would expect that firms with positive prior-quarter UE will experience positive current-quarter UE, and therefore would not trade intensively in this sub-sample. In contrast, short-sellers would expect negative current-quarter UE for firms with negative prior-quarter UE, and would short-sell them pre-earnings announcements.

Panel A in Table 6 reports the R^2_{DIFF} from estimating model (1) for pilot and control firms with positive prior-quarter UE during Reg SHO. Row 1 reports the R^2_{DIFF} when the RHS return-window is RET_i(*pre_announce*). With various windows of RET_i(*quarterly*), the R^2_{DIFF} is 0.03-0.08 (significant at conventional levels) and comparable, even stronger, than that for firms with negative prior-quarter UE in Row 1 of Panel B. This is inconsistent with the prediction that short-sellers employ prior-quarter earnings in their trading, and hence mitigates the concern that the main results (in Table 2) are attributable to this source of publicly available information (i.e. prior-quarter earnings).

[Insert Table 6 about here]

Growth vs. value firms

Prior studies (e.g., Fama and French 1992; Lakonishok, Shleifer, and Vishny 1994) document that high growth firms experience low returns. One explanation is that high growth firms experience asymmetric market reactions to unfavourable earnings news relative to value firms (Skinner and Sloan 2002). An implication of this finding to short-sellers is that they can short firms of high growth because those firms provide short-sellers with a greater potential for profits when the earnings news is unfavourable, in comparison to value firms. To investigate this I partitioned firms into two sub-samples: firms with small prior-quarter market-to-book equity ratios (MTB), and those with large MTB. If short-sellers trade on MTB, they would short more intensively before unfavourable earnings news in a sub-sample with large prior-quarter MTB.

Panel A in Table 7 reports the R^2_{DIFF} from estimating model (1) for pilot and control firms with small prior-quarter MTB during Reg SHO. Row 1 reports the R^2_{DIFF} when the RHS return-window is RET_i(*pre_announce*). With various windows of RET_i(*quarterly*), the R^2_{DIFF} is in the range of 0.003-0.12, and statistically significant at the conventional levels in most cases. This is comparable with the R^2_{DIFF} for firms with large prior-quarter MTB in Row 1 of Panel B. This finding suggests that short-sellers do not rely on MTB in trading before unfavourable earnings news, reinforcing that the findings in Table 2 are attributable to short-sellers' private information relating to upcoming earnings.

[Insert Table 7 about here]

Further Analysis

Post-earnings-announcement Drift (PEAD)

PEAD is a well-known measure of price efficiency. If short-sellers are informed investors, via either a private or a public channel, and their trading improves stock price informativeness, I expect a smaller PEAD for the pilot firms during Reg SHO. In contrast, if short-selling is uninformed trading, PEAD is expected to show no change or be even larger. To investigate the effect of short-selling on PEAD, I redefine RET_i(*quarterly*) in model (1) as buy-and-hold abnormal returns from days -1 to +31, namely [-1, +31]. In addition, the RHS is RET_i(*dur_announce*) only.[24]

[24] By design, there are only two sub-periods in this test: *RET*(*dur_announce*) and *RET*(*post_announce*).

This modification is illustrated in the Fig. 1, Panel B. Following Ball and Shivakumar (2008), stock price efficiency is measured by comparing the coefficient of RET_i(*dur_announce*) in model (1) with unity; that is, the price underreacts/overreacts to earnings if the coefficient is greater/lesser than unity.

Panel A in Table 8 reports the coefficient of RET_i(*dur_announce*) for pilot and control firms pre-Reg SHO. When the window of RET_i(*quarterly*) is [-1, +7], the coefficient for pilot/control firms is 1.03/1.03 (greater than 1 at the 5 percent significance level), suggesting an under-reaction to earnings announcements for both pilot and control firms. In addition, the difference between these two coefficients is 0.001 and statistically not significant (t = -0.06), consistent with the effective random selection procedure in the sample construction. When RET_i(*quarterly*) is measured at other event-windows, the coefficient for pilot/control firms is consistently greater than 1, and the same inference can be drawn.

Panel B in Table 8 reports the coefficient of RET_i(*dur_announce*) during Reg SHO. When the window of RET_i(*quarterly*) is [-1, +31], the coefficient for pilot firms is 0.96 which is not significantly different from 1 (t = -1.05), suggesting that short-selling removes PEAD, and is consistent with the notion that short-sellers do not primarily drive prices away from fundamentals (Boehmer and Wu 2013). The coefficient for controls firms is 1.07, and is significantly different from 1 (t = 2.68), suggesting control firms experience PEAD. In addition, the difference in these two coefficients, -0.1, is significantly different from 0 (t = -2.43), reinforcing the effect of short-selling on reducing pilot firms' PEAD. When RET_i(*quarterly*) is measured at other event-windows, the coefficient for pilot/control firms is consistently not greater/greater than 1, and the same inference can be drawn. In sum, the above results suggest that short-sellers reduce PEAD and improve the informativeness of stock prices (Saffi and Sigurdsson 2010).

[Insert Table 8 about here]

Post Reg SHO (after July 2007)

The SEC lifted the price-test for all firms from July 2007, which implies that short-sellers incurred the same cost of short-selling pilot and control groups post Reg SHO. Therefore, the information arrival around earnings announcements would be similar between the two groups post-Reg SHO. To examine this implication, I re-estimated model (1) for the one year immediately after expiration of Reg SHO (July 2007-June 2008). If the reported findings in Table 2 are due to the changes of short-selling cost, I should observe no difference in R^2 between pilot and control groups post-Reg SHO. Untabulated results show some supporting evidence.

VI. CONCLUSION

In this study, I examine when and how short-sellers are informed by exploiting a quasi-natural experiment setting – Reg SHO. During the implementation of Reg SHO, pilot firms increase (decrease) their price informativeness pre- (during and post-) earnings announcements than control firms do. These results are consistent with the notion that short-sellers are informed investors, and they have private channels to acquire information. The results are robust to various time-frame windows centred on earnings announcements.

I contribute to the literature by documenting that a predominant section of short-sellers are informed via private channel, and increase price informativeness in a more timely manner. Furthermore, I provide some evidence that opaque firms' information environments increase short-sellers' private information collection to fill the gap of information asymmetry between managers and investors. Finally, this study documents that short-sellers do not disturb the market when bad news (e.g. negative earnings news) is announced. Instead, they impound such news more efficiently so that the well-documented PEAD is eliminated.

References

Asquith, P., P. A. Pathak, and J. R. Ritter. 2005. Short interest, institutional ownership, and stock returns. *Journal of Financial Economics* 78 (2):243-276.

Atiase, R. K. 1985. Predisclosure information, firm capitalization, and security price behavior around earnings announcements. *Journal of Accounting Research*:21-36.

Ball, R., and L. Shivakumar. 2008. How much new information is there in earnings? *Journal of Accounting Research* 46 (5):975-1016.

Barth, M. E., R. Kasznik, and M. F. McNichols. 2001. Analyst coverage and intangible assets. *Journal of Accounting Research* 39 (1):1-34.

Barth, M. E., Y. Konchitchki, and W. R. Landsman. 2013. Cost of capital and earnings transparency. *Journal of Accounting and Economics* 55 (2):206-224.

Barth, M. E., W. R. Landsman, and M. H. Lang. 2008. International accounting standards and accounting quality. *Journal of Accounting Research* 46 (3):467-498.

Bernard, V. L., and J. K. Thomas. 1990. Evidence that stock prices do not fully reflect the implications of current earnings for future earnings. *Journal of Accounting and Economics* 13 (4):305-340.

Beyer, A., D. A. Cohen, T. Z. Lys, and B. R. Walther. 2010. The financial reporting environment: Review of the recent literature. *Journal of Accounting and Economics* 50 (2):296-343.

Bhattacharya, N., E. L. Black, T. E. Christensen, and R. D. Mergenthaler. 2007. Who trades on pro forma earnings information? *The Accounting Review* 82 (3):581-619.

Blau, B. M., and J. M. Pinegar. 2013. Are short sellers incrementally informed prior to earnings announcements? *Journal of Empirical Finance* 21:142-155.

Boehmer, E., C. M. Jones, and X. Zhang. 2012. What do short sellers know? *Available at SSRN 2192958*.

Boehmer, E., and J. J. Wu. 2013. Short selling and the price discovery process. *Review of Financial Studies* 26 (2):287-322.

Christophe, S. E., M. G. Ferri, and J. J. Angel. 2004. Short - selling prior to earnings announcements. *The Journal of Finance* 59 (4):1845-1876.

Christophe, S. E., M. G. Ferri, and J. Hsieh. 2010. Informed trading before analyst downgrades: Evidence from short sellers. *Journal of Financial Economics* 95 (1):85-106.

Clinch, G., W. Li, and Y. Zhang. 2015. Short Selling and Firms' Disclosure of Bad News: Evidence from Regulation SHO. *Available at SSRN*.

Curtis, A., and N. L. Fargher. 2014. Does short selling amplify price declines or align stocks with their fundamental values? *Management Science* 60 (9):2324-2340.

Desai, H., S. Krishnamurthy, and K. Venkataraman. 2006. Do short sellers target firms with poor earnings quality? Evidence from earnings restatements. *Review of Accounting Studies* 11 (1):71-90.

Diamond, D. W., and R. E. Verrecchia. 1987. Constraints on short-selling and asset price adjustment to private information. *Journal of Financial Economics* 18 (2):277-311.

Diether, K. B., K.-H. Lee, and I. M. Werner. 2009a. Short-sale strategies and return predictability. *Review of Financial Studies* 22 (2):575-607.

Diether, K. B., K. H. Lee, and I. M. Werner. 2009b. It's SHO time! Short‐sale price tests and market quality. *The Journal of Finance* 64 (1):37-73.

Drake, M. S., L. Rees, and E. P. Swanson. 2011. Should investors follow the prophets or the bears? Evidence on the use of public information by analysts and short sellers. *The Accounting Review* 86 (1):101-130.

Engelberg, J. E., A. V. Reed, and M. C. Ringgenberg. 2012. How are shorts informed?: Short sellers, news, and information processing. *Journal of Financial Economics* 105 (2):260-278.

Fama, E. F., and K. R. French. 1992. The cross‐section of expected stock returns. *The Journal of Finance* 47 (2):427-465.

Fang, V. W., A. H. Huang, and J. M. Karpoff. 2016. Short selling and earnings management: A controlled experiment. *The Journal of Finance* 71 (3):1251–1294.

Francis, J., R. LaFond, P. M. Olsson, and K. Schipper. 2004. Costs of equity and earnings attributes. *The Accounting Review* 79 (4):967-1010.

Graham, J. R., C. R. Harvey, and S. Rajgopal. 2005. The economic implications of corporate financial reporting. *Journal of Accounting and Economics* 40 (1):3-73.

Grullon, G., S. Michenaud, and J. P. Weston. 2015. The real effects of short-selling constraints. *Review of Financial Studies* 28 (6):1737-1767.

Joy, O. M., R. H. Litzenberger, and R. W. McEnally. 1977. The adjustment of stock prices to announcements of unanticipated changes in quarterly earnings. *Journal of Accounting Research*:207-225.

Karpoff, J. M., and X. Lou. 2010. Short sellers and financial misconduct. *The Journal of Finance* 65 (5):1879-1913.

Kyle, A. S. 1985. Continuous auctions and insider trading. *Econometrica: Journal of the Econometric Society*:1315-1335.

Lakonishok, J., A. Shleifer, and R. W. Vishny. 1994. Contrarian investment, extrapolation, and risk. *The Journal of Finance* 49 (5):1541-1578.

Latane, H. A., and C. P. Jones. 1979. Standardized unexpected earnings. *The Journal of Finance* 34 (3):717-724.

Richardson, S. A., R. G. Sloan, M. T. Soliman, and I. Tuna. 2005. Accrual reliability, earnings persistence and stock prices. *Journal of Accounting and Economics* 39 (3):437-485.

Rogers, J. L., and A. Van Buskirk. 2013. Bundled forecasts in empirical accounting research. *Journal of Accounting and Economics* 55 (1):43-65.

Saffi, P. A., and K. Sigurdsson. 2010. Price efficiency and short selling. *Review of Financial Studies* 24 (3):821-852.

Senchack, A. J., and L. T. Starks. 1993. Short-sale restrictions and market reaction to short-interest announcements. *Journal of Financial and Quantitative Analysis* 28 (2):177-194.

Skinner, D. J., and R. G. Sloan. 2002. Earnings surprises, growth expectations, and stock returns or don't let an earnings torpedo sink your portfolio. *Review of Accounting Studies* 7 (2-3):289-312.

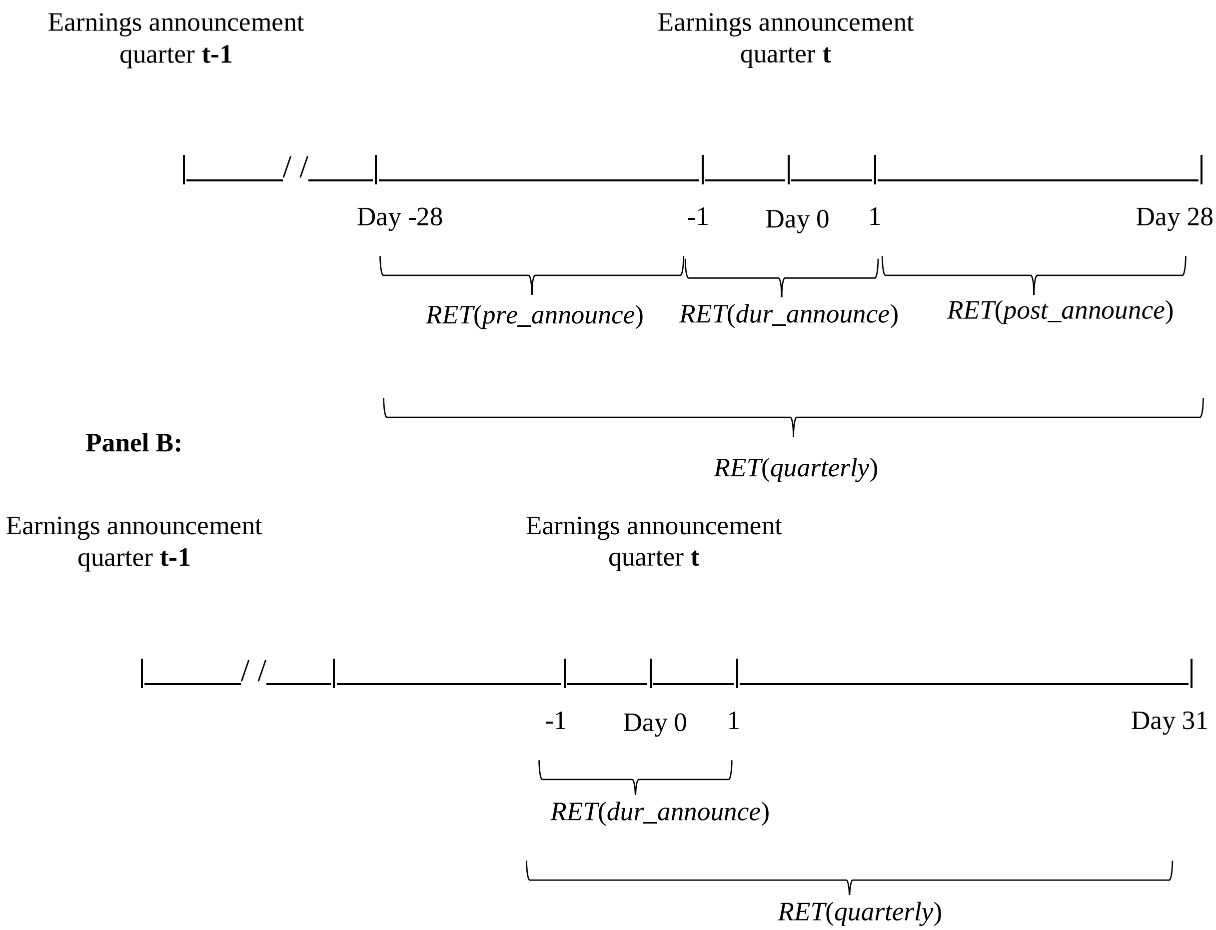
Sloan, R. 1996. Do stock prices fully reflect information in accruals and cash flows about future earnings?(Digest summary). *The Accounting Review* 71 (3):289-315.

Verrecchia, R. E. 1982. The use of mathematical models in financial accounting. *Journal of Accounting Research*:1-42.

Figure 1

Time frame for computing stock returns for firm *i* at quarter t pre (*RET*(*pre_announce*)) , during (*RET*(*dur_announce*)), post (*RET*(*post_announce*)) earnings announcements and quarterly returns (*RET*(*quarterly*)).

Panel A:



Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns). *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns before earnings announcement. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns after earnings announcement.

Table 1

Summary statistics of sample firms before Reg SHO announcement

	pilot group			*control* group			Difference in mean
	# obs.	Mean	std. dev.	# obs.	Mean	std. dev.	(pilot-control)
RET(*pre_announce*)	7058	0.011	0.148	14369	0.013	0.158	-0.002
RET(dur_announce)	7058	0.004	0.081	14369	0.004	0.090	0
RET(*post_announce*)	7058	0.025	0.147	14369	0.025	0.159	0
RET(*quarterly*)	7058	0.040	0.235	14369	0.042	0.253	-0.002
SIZE	7058	6.925	1.715	14369	6.943	1.829	-0.018
ROA	7058	0.005	0.047	14369	0.001	0.059	0.004***
MTB	7058	3.045	44.698	14369	4.590	178.384	-1.546

The sample is comprised of firm-quarters before the announcement of Reg SHO (06/01/2002 - 07/28/2004). The *pilot group* is comprised of the Russell 3000 components that are on the pilot list of Reg SHO in June 2004. The *control group* is comprised of all other components on the Russell 3000. Mean differences from zero in varibles between pilot and control groups (assumed independent samples) are tested using two-sample t-tests (unpaired).

Variable Definitions:

RET(*pre_announce*) =	value-weighted adjusted accumulative returns at days of [-28 -2], where date 0 is the earnings announcement date;
RET(*dur_announce*) =	value-weighted adjusted accumulative returns at days of [-1 +1], where date 0 is the earnings announcement date;
RET(*post_announce*) =	value-weighted adjusted accumulative returns at days of [+2 +28], where date 0 is the earnings announcement date;
RET(*quarterly*) =	value-weighted adjusted accumulative returns at days of [-28, +28], where date 0 is the earnings announcement date;
SIZE =	logarithm of the market value of equity at the beginning of a fiscal quarter;
MTB =	ratio of market value of equity to book value at the beginning of a fiscal quarter;
ROA =	earnings before extraordinary items scaled by lagged total assets

Table 2

Effect of Reg SHO on price informativeness

		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.13	0.21	0.27	0.30	0.34	0.36	0.37	0.37	0.38
	R^2_{pilot}	0.14	0.23	0.29	0.36	0.38	0.40	0.42	0.44	0.45
	R^2_{DIFF}	**0.02**	**0.03**	**0.02**	**0.06**	**0.04**	**0.05**	**0.05**	**0.06**	**0.06**
	p-value	0.030	0.000	0.090	0.000	0.002	0.002	0.000	0.000	0.000
RET(*dur_announce*)	$R^2_{control}$	0.64	0.49	0.40	0.34	0.29	0.26	0.24	0.22	0.19
	R^2_{pilot}	0.65	0.45	0.38	0.31	0.26	0.22	0.20	0.18	0.16
	R^2_{DIFF}	**0.01**	**-0.03**	**-0.02**	**-0.03**	**-0.03**	**-0.04**	**-0.04**	**-0.04**	**-0.03**
	p-value	0.460	0.012	0.030	0.016	0.032	0.000	0.004	0.002	0.006
RET(*post_announce*)	$R^2_{control}$	0.21	0.31	0.35	0.35	0.36	0.36	0.36	0.38	0.38
	R^2_{pilot}	0.15	0.23	0.26	0.29	0.30	0.32	0.33	0.33	0.34
	R^2_{DIFF}	**-0.06**	**-0.07**	**-0.09**	**-0.07**	**-0.06**	**-0.04**	**-0.03**	**-0.05**	**-0.03**
	p-value	0.012	0.006	0.000	0.000	0.000	0.136	0.040	0.000	0.090

Sample period is from 2005 to 2007 (during Reg SHO). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -*t* to +*t* (designated [-*t*, +*t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days -*t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Table 3

Management forecasts and the effect of Reg SHO on price informativeness

Panel A: Subsample without management forecasts

		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.12	0.19	0.26	0.28	0.33	0.34	0.35	0.36	0.37
	R^2_{pilot}	0.14	0.22	0.28	0.35	0.38	0.39	0.41	0.42	0.43
	R^2_{DIFF}	**0.02**	**0.03**	**0.02**	**0.07**	**0.05**	**0.06**	**0.06**	**0.06**	**0.07**
	p-value	0.008	0.002	0.026	0.000	0.000	0.000	0.004	0.004	0.000
RET(*dur_announce*)	$R^2_{control}$	0.64	0.49	0.41	0.36	0.30	0.27	0.26	0.23	0.20
	R^2_{pilot}	0.65	0.47	0.39	0.32	0.27	0.23	0.21	0.19	0.17
	R^2_{DIFF}	**0.01**	**-0.03**	**-0.02**	**-0.03**	**-0.03**	**-0.04**	**-0.04**	**-0.04**	**-0.03**
	p-value	0.498	0.024	0.038	0.080	0.070	0.024	0.009	0.006	0.032
RET(*post_announce*)	$R^2_{control}$	0.21	0.30	0.36	0.36	0.37	0.36	0.37	0.39	0.39
	R^2_{pilot}	0.15	0.23	0.26	0.29	0.31	0.33	0.34	0.34	0.35
	R^2_{DIFF}	**-0.06**	**-0.07**	**-0.09**	**-0.08**	**-0.06**	**-0.04**	**-0.04**	**-0.05**	**-0.04**
	p-value	0.038	0.022	0.000	0.000	0.028	0.282	0.142	0.000	0.054

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms that issue no management forecasts prior to earnings announcements. Management forecast (MF) is an indicator variable equal to one if a firm issues at least one management forecast before earnings announcement and zero otherwise (Source: I/B/E/S guidance). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days *-t* to *+t* (designated [*-t*, *+t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days *-t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to *+t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Panel B: Subsample with management forecasts

RHS variable		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.20	0.35	0.42	0.48	0.53	0.51	0.55	0.53	0.52
	R^2_{pilot}	0.19	0.39	0.45	0.48	0.48	0.54	0.57	0.62	0.61
	R^2_{DIFF}	**-0.01**	**0.05**	**0.03**	**0.01**	**-0.05**	**0.03**	**0.02**	**0.10**	**0.09**
	p-value	0.632	0.354	0.292	0.254	0.666	0.166	0.344	0.000	0.010
RET(*dur_announce*)	$R^2_{control}$	0.57	0.39	0.26	0.20	0.16	0.15	0.12	0.11	0.10
	R^2_{pilot}	0.49	0.22	0.15	0.13	0.12	0.06	0.07	0.07	0.07
	R^2_{DIFF}	**-0.08**	**-0.18**	**-0.11**	**-0.07**	**-0.04**	**-0.09**	**-0.05**	**-0.04**	**-0.03**
	p-value	0.086	0.000	0.000	0.000	0.098	0.002	0.202	0.240	0.280
RET(*post_announce*)	$R^2_{control}$	0.25	0.38	0.31	0.27	0.26	0.29	0.28	0.30	0.25
	R^2_{pilot}	0.18	0.28	0.23	0.29	0.21	0.23	0.22	0.23	0.24
	R^2_{DIFF}	**-0.07**	**-0.10**	**-0.08**	**0.02**	**-0.05**	**-0.06**	**-0.06**	**-0.07**	**0.01**
	p-value	0.268	0.034	0.116	0.618	0.012	0.102	0.042	0.014	0.432

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms that issue at least one management forecast prior to earnings announcements. Management forecast (MF) is an indicator variable equal to one if a firm issues at least one management forecast before earnings announcement and zero otherwise (Source: I/B/E/S guidance). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -*t* to +*t* (designated [-*t*, +*t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days -*t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Table 4

Earnings transparency and the effect of Reg SHO on price informativeness

Panel A: Subsample with low earnings transparency

		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.13	0.21	0.27	0.28	0.32	0.35	0.36	0.38	0.39
	R^2_{pilot}	0.16	0.24	0.29	0.35	0.39	0.42	0.44	0.46	0.47
	R^2_{DIFF}	**0.02**	**0.03**	**0.02**	**0.06**	**0.07**	**0.07**	**0.08**	**0.08**	**0.08**
	p-value	0.164	0.094	0.122	0.000	0.000	0.000	0.000	0.000	0.000
RET(*dur_announce*)	$R^2_{control}$	0.63	0.50	0.40	0.35	0.29	0.26	0.24	0.22	0.19
	R^2_{pilot}	0.65	0.47	0.40	0.32	0.26	0.22	0.22	0.19	0.19
	R^2_{DIFF}	**0.02**	**-0.03**	**0.00**	**-0.03**	**-0.03**	**-0.04**	**-0.02**	**-0.03**	**-0.01**
	p-value	0.000	0.404	0.324	0.460	0.496	0.324	0.682	0.350	0.650
RET(*post_announce*)	$R^2_{control}$	0.21	0.31	0.38	0.39	0.41	0.41	0.41	0.39	0.37
	R^2_{pilot}	0.16	0.26	0.26	0.27	0.32	0.34	0.34	0.35	0.35
	R^2_{DIFF}	**-0.05**	**-0.05**	**-0.13**	**-0.12**	**-0.10**	**-0.07**	**-0.08**	**-0.04**	**-0.02**
	p-value	0.074	0.016	0.000	0.000	0.000	0.000	0.000	0.008	0.202

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with earnings transparency below the median of earnings transparency of the full sample. Earnings transparency is derived from a two-step procedure. In step 1, I regress firms' annual returns on earnings and change in earnings, grouped by industry-year, which allows industry variation in the measure, and save the first R^2. In step 2, I construct a quartile portfolio based upon the residuals from Step 1, re-estimate the regression model within each portfolio annually, and save the second R^2. The sum of the two R^2 is the transparency measure. See Barth et al. (2013). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days $-t$ to $+t$ (designated $[-t, +t]$), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days $-t$ to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to $+t$. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Panel B: Subsample with high earnings transparency

RHS variable		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0) [-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.12	0.19	0.27	0.31	0.33	0.34	0.34	0.36	0.36
	R^2_{pilot}	0.12	0.19	0.24	0.31	0.30	0.31	0.33	0.35	0.36
	R^2_{DIFF}	**-0.01**	**0.00**	**-0.03**	**0.00**	**-0.03**	**-0.03**	**-0.01**	**-0.01**	**0.00**
	p-value	0.046	0.018	0.106	0.086	0.464	0.420	0.638	0.486	0.230
RET(*dur_announce*)	$R^2_{control}$	0.66	0.50	0.40	0.34	0.30	0.25	0.24	0.21	0.19
	R^2_{pilot}	0.64	0.47	0.40	0.32	0.29	0.25	0.22	0.20	0.19
	R^2_{DIFF}	**-0.02**	**-0.03**	**0.00**	**-0.02**	**-0.01**	**0.00**	**-0.01**	**-0.01**	**-0.01**
	p-value	0.086	0.054	0.108	0.124	0.182	0.178	0.178	0.192	0.298
RET(*post_announce*)	$R^2_{control}$	0.18	0.26	0.30	0.31	0.30	0.30	0.29	0.32	0.33
	R^2_{pilot}	0.15	0.22	0.24	0.28	0.28	0.28	0.28	0.28	0.27
	R^2_{DIFF}	**-0.03**	**-0.04**	**-0.07**	**-0.03**	**-0.02**	**-0.02**	**-0.01**	**-0.05**	**-0.06**
	p-value	0.498	0.104	0.006	0.060	0.166	0.412	0.198	0.000	0.004

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with earnings transparency below the median of earnings transparency of the full sample. Earnings transparency is derived from a two-step procedure. In step 1, I regress firms' annual returns on earnings and change in earnings, grouped by industry-year, which allows industry variation in the measure, and save the first R^2. In step 2, I construct a quartile portfolio based upon the residuals from Step 1, re-estimate the regression model within each portfolio annually, and save the second R^2. The sum of the two R^2 is the transparency measure. See Barth et al. (2013). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -*t* to +*t* (designated [-*t*, +*t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days -*t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Table 5

Analyst coverage and the effect of Reg SHO on price informativeness

Panel A: Subsample with low analyst coverage

		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.09	0.18	0.25	0.26	0.33	0.34	0.35	0.36	0.37
	R^2_{pilot}	0.15	0.26	0.28	0.34	0.38	0.39	0.40	0.43	0.43
	R^2_{DIFF}	**0.06**	**0.07**	**0.03**	**0.09**	**0.05**	**0.05**	**0.05**	**0.08**	**0.06**
	p-value	0.002	0.004	0.208	0.000	0.028	0.000	0.000	0.000	0.000
RET(*dur_announce*)	$R^2_{control}$	0.63	0.47	0.38	0.33	0.29	0.26	0.24	0.21	0.17
	R^2_{pilot}	0.64	0.43	0.34	0.28	0.24	0.22	0.20	0.18	0.16
	R^2_{DIFF}	**0.02**	**-0.03**	**-0.03**	**-0.05**	**-0.04**	**-0.04**	**-0.04**	**-0.03**	**-0.01**
	p-value	0.478	0.174	0.138	0.082	0.122	0.048	0.074	0.176	0.234
RET(*post_announce*)	$R^2_{control}$	0.26	0.34	0.39	0.38	0.39	0.38	0.39	0.39	0.39
	R^2_{pilot}	0.15	0.24	0.28	0.28	0.29	0.31	0.36	0.37	0.39
	R^2_{DIFF}	**-0.11**	**-0.10**	**-0.11**	**-0.10**	**-0.10**	**-0.07**	**-0.03**	**-0.02**	**0.00**
	p-value	0.004	0.002	0.000	0.000	0.000	0.008	0.090	0.088	0.546

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with the number of analyst below the median of the number of analyst of the full sample (Source: I/B/E/S). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -*t* to +*t* (designated [-*t*, +*t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days -*t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Panel B: Subsample with high analyst coverage

RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RET(*pre_announce*)	$R^2_{control}$	0.17	0.24	0.30	0.35	0.37	0.37	0.40	0.40	0.41
	R^2_{pilot}	0.13	0.21	0.30	0.37	0.39	0.42	0.44	0.44	0.48
	R^2_{DIFF}	**-0.04**	**-0.03**	**0.00**	**0.02**	**0.02**	**0.05**	**0.04**	**0.05**	**0.07**
	p-value	0.362	0.312	0.122	0.172	0.018	0.002	0.128	0.048	0.000
RET(*dur_announce*)	$R^2_{control}$	0.66	0.50	0.42	0.35	0.29	0.26	0.23	0.22	0.21
	R^2_{pilot}	0.65	0.47	0.41	0.34	0.28	0.22	0.21	0.17	0.16
	R^2_{DIFF}	**-0.01**	**-0.03**	**-0.01**	**-0.01**	**-0.01**	**-0.03**	**-0.03**	**-0.05**	**-0.05**
	p-value	0.468	0.022	0.066	0.186	0.138	0.064	0.128	0.044	0.052
RET(*post_announce*)	$R^2_{control}$	0.15	0.26	0.30	0.32	0.32	0.32	0.33	0.37	0.36
	R^2_{pilot}	0.15	0.22	0.24	0.29	0.32	0.33	0.30	0.29	0.29
	R^2_{DIFF}	**-0.01**	**-0.04**	**-0.06**	**-0.02**	**-0.01**	**0.00**	**-0.03**	**-0.08**	**-0.07**
	p-value	0.304	0.068	0.078	0.350	0.402	0.786	0.102	0.002	0.004

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with the number of analyst above the median of the number of analyst of the full sample (Source: I/B/E/S). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -*t* to +*t* (designated [-*t*, +*t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days -*t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Table 6

Prior-quarter unexpected earnings (UE) and the effect of Reg SHO on price informativeness

Panel A: Subsample with positive prior-quarter UE

		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.13	0.19	0.27	0.30	0.34	0.35	0.36	0.37	0.38
	R^2_{pilot}	0.12	0.22	0.32	0.38	0.38	0.39	0.43	0.44	0.44
	R^2_{DIFF}	**-0.01**	**0.03**	**0.06**	**0.08**	**0.04**	**0.04**	**0.06**	**0.07**	**0.07**
	p-value	0.108	0.000	0.002	0.000	0.004	0.000	0.000	0.000	0.000
RET(*dur_announce*)	$R^2_{control}$	0.63	0.49	0.41	0.35	0.29	0.26	0.23	0.21	0.18
	R^2_{pilot}	0.66	0.50	0.38	0.31	0.27	0.23	0.21	0.19	0.16
	R^2_{DIFF}	**0.04**	**0.01**	**-0.02**	**-0.04**	**-0.02**	**-0.03**	**-0.02**	**-0.02**	**-0.02**
	p-value	0.524	0.051	0.028	0.016	0.012	0.002	0.004	0.000	0.000
RET(*post_announce*)	$R^2_{control}$	0.21	0.28	0.33	0.35	0.35	0.34	0.37	0.38	0.38
	R^2_{pilot}	0.13	0.19	0.24	0.27	0.30	0.33	0.36	0.34	0.33
	R^2_{DIFF}	**-0.07**	**-0.09**	**-0.09**	**-0.08**	**-0.05**	**-0.01**	**-0.01**	**-0.04**	**-0.04**
	p-value	0.012	0.016	0.008	0.000	0.000	0.156	0.004	0.002	0.030

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with positive prior-quarter unexpected earnings (UE), defined as the difference between actual earnings and analyst consensus (Source: I/B/E/S). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -*t* to +*t* (designated [-*t*, +*t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days -*t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Panel B: Subsample with negative prior-quarter UE

RHS variable		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0) [-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.12	0.22	0.28	0.30	0.35	0.36	0.38	0.38	0.39
	R^2_{pilot}	0.17	0.25	0.26	0.34	0.39	0.41	0.41	0.44	0.46
	R^2_{DIFF}	**0.05**	**0.03**	**-0.02**	**0.04**	**0.04**	**0.06**	**0.04**	**0.06**	**0.06**
	p-value	0.028	0.170	0.704	0.092	0.034	0.006	0.088	0.000	0.000
RET(*dur_announce*)	$R^2_{control}$	0.66	0.48	0.39	0.33	0.29	0.26	0.25	0.23	0.20
	R^2_{pilot}	0.63	0.40	0.37	0.30	0.26	0.21	0.19	0.17	0.16
	R^2_{DIFF}	**-0.03**	**-0.08**	**-0.02**	**-0.02**	**-0.03**	**-0.05**	**-0.06**	**-0.06**	**-0.04**
	p-value	0.406	0.000	0.092	0.152	0.420	0.186	0.276	0.190	0.566
RET(*post_announce*)	$R^2_{control}$	0.22	0.33	0.38	0.36	0.37	0.37	0.36	0.38	0.37
	R^2_{pilot}	0.17	0.27	0.28	0.30	0.31	0.31	0.31	0.33	0.35
	R^2_{DIFF}	**-0.06**	**-0.06**	**-0.10**	**-0.06**	**-0.06**	**-0.06**	**-0.05**	**-0.06**	**-0.02**
	p-value	0.178	0.016	0.000	0.096	0.278	0.432	0.264	0.184	0.512

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with negative prior-quarter unexpected earnings (UE), defined as the difference between actual earnings and analyst consensus (Source: I/B/E/S). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days *-t* to *+t* (designated [*-t*, *+t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days *-t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Table 7

Prior-quarter market-to-book ratio (MTB) and the effect of Reg SHO on price informativeness

Panel A: Subsample with small prior-quarter MTB

		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.13	0.21	0.27	0.31	0.35	0.38	0.37	0.36	0.38
	R^2_{pilot}	0.13	0.20	0.31	0.37	0.40	0.43	0.45	0.48	0.48
	R^2_{DIFF}	**0.003**	**-0.01**	**0.04**	**0.06**	**0.05**	**0.05**	**0.08**	**0.12**	**0.10**
	p-value	0.012	0.272	0.148	0.048	0.054	0.010	0.020	0.002	0.000
RET(*dur_announce*)	$R^2_{control}$	0.64	0.49	0.41	0.35	0.30	0.26	0.25	0.23	0.20
	R^2_{pilot}	0.63	0.44	0.35	0.28	0.24	0.19	0.16	0.14	0.12
	R^2_{DIFF}	**-0.01**	**-0.04**	**-0.06**	**-0.07**	**-0.07**	**-0.07**	**-0.09**	**-0.09**	**-0.08**
	p-value	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RET(*post_announce*)	$R^2_{control}$	0.26	0.36	0.39	0.38	0.40	0.40	0.40	0.41	0.40
	R^2_{pilot}	0.18	0.27	0.27	0.30	0.32	0.36	0.39	0.38	0.39
	R^2_{DIFF}	**-0.08**	**-0.09**	**-0.12**	**-0.07**	**-0.08**	**-0.03**	**-0.01**	**-0.03**	**-0.01**
	p-value	0.084	0.002	0.000	0.032	0.022	0.049	0.274	0.004	0.172

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with prior-quarter market-to-book ratio (MTB) below the median of MTB for the full sample. MTB is defined as the ratio of market value of equity divided by the book value of equity (Source: COMPUSTAT). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days *-t* to *+t* (designated [*-t*, *+t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days *-t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Panel B: Subsample with large prior-quarter MTB

		Window of *RET*(*quarterly*): day relative to earnings announcements (day 0)								
RHS variable		[-4, +4]	[-7, +7]	[-10, +10]	[-13, +13]	[-16, +16]	[-19, +19]	[-22, +22]	[-25, +25]	[-28, +28]
RET(*pre_announce*)	$R^2_{control}$	0.13	0.20	0.28	0.28	0.34	0.34	0.37	0.39	0.39
	R^2_{pilot}	0.15	0.25	0.28	0.34	0.37	0.39	0.39	0.41	0.43
	R^2_{DIFF}	**0.03**	**0.05**	**0.00**	**0.06**	**0.03**	**0.05**	**0.03**	**0.02**	**0.04**
	p-value	0.182	0.036	0.196	0.000	0.028	0.006	0.038	0.014	0.014
RET(*dur_announce*)	$R^2_{control}$	0.64	0.48	0.39	0.33	0.28	0.26	0.23	0.20	0.18
	R^2_{pilot}	0.66	0.46	0.39	0.33	0.29	0.24	0.24	0.21	0.20
	R^2_{DIFF}	**0.02**	**-0.03**	**0.00**	**0.00**	**0.01**	**-0.01**	**0.01**	**0.00**	**0.02**
	p-value	0.712	0.368	0.560	0.638	0.754	0.462	0.762	0.690	0.840
RET(*post_announce*)	$R^2_{control}$	0.18	0.26	0.32	0.33	0.32	0.32	0.33	0.35	0.35
	R^2_{pilot}	0.12	0.21	0.26	0.27	0.29	0.29	0.29	0.29	0.30
	R^2_{DIFF}	**-0.05**	**-0.05**	**-0.06**	**-0.06**	**-0.04**	**-0.03**	**-0.05**	**-0.06**	**-0.05**
	p-value	0.124	0.102	0.098	0.002	0.010	0.310	0.112	0.048	0.126

Sample period is from 2005 to 2007 (during Reg SHO). The sample is comprised of firms with prior-quarter market-to-book ratio (MTB) above the median of MTB. MTB is defined as the ratio of market value of equity divided by the book value of equity (Source: COMPUSTAT). This table presents the R^2 for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns in sub-period returns -- *RET*(*pre_announce*), *RET*(*dur_announce*) and *RET*(*post_announce*) around earnings announcements, respectively.

$$RET(quarterly) = \beta_0 + \beta_1 RET(sub\_period) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days *-t* to *+t* (designated [*-t*, *+t*]), relative to earnings-announcement date, day 0. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. Returns before earnings announcements, *RET*(*pre_announce*), are buy-and-hold abnormal returns at days *-t* to -2. Returns during post-announcement period, *RET*(*post_announce*), are buy-and-hold abnormal returns at days +2 to +*t*. The statistic test of the difference in R^2 during Reg SHO (i.e., R^2_{DIFF}) is based on the empirical distribution of the R^2_{DIFF} in the pre-Reg SHO period. Specifically, I randomly select, with replacement, eight quarters from the twenty quarters immediately before the Reg SHO announcements and re-estimate the model (1). Each time, I collect one R^2_{DIFF} between pilot and control firms. By repeating this procedure 1000 times, I obtain an empirical distribution of R^2_{DIFF} (with 1000 observations) based on the pre-Reg SHO period. I assume that this empirical distribution reflects the distribution of R^2_{DIFF} under the null hypothesis of no difference in short-selling between pilot and control firms. The p-value of the R^2_{DIFF} is provided.

Table 8

The effect of short-selling on post-earnings announcement drift

Panel A: Before Reg SHO

	[-1, +7]	t-stat H_0: β=1	[-1, +10]	t-stat H_0: β=1	[-1, +13]	t-stat H_0: β=1	[-1, +16]	t-stat H_0: β=1	[-1, +25]	t-stat H_0: β=1	[-1, +28]	t-stat H_0: β=1	[-1, +31]	t-stat H_0: β=1
$\beta_{control}$	1.03	**2.76**	1.06	**3.81**	1.06	**2.90**	1.06	**2.57**	1.06	**2.30**	1.08	**2.56**	1.06	**1.94**
Std. error	(0.01)		(0.02)		(0.02)		(0.02)		(0.03)		(0.03)		(0.03)	
β_{pilot}	1.03	**2.87**	1.03	**2.11**	1.04	**2.54**	1.05	**2.75**	1.05	**1.92**	1.04	**1.38**	1.03	**1.20**
Std. error	(0.01)		(0.01)		(0.02)		(0.02)		(0.02)		(0.03)		(0.03)	
β_{pilot} - $\beta_{control}$	0.00		-0.03		-0.01		0.00		-0.02		-0.04		-0.03	
t-stat H_0: $\beta_{pilot} = \beta_{control}$	**-0.06**		**-1.45**		**-0.51**		**-0.14**		**-0.49**		**-1.03**		**-0.70**	

Panel B: During Reg SHO

	[-1, +7]	t-stat H_0: β=1	[-1, +10]	t-stat H_0: β=1	[-1, +13]	t-stat H_0: β=1	[-1, +16]	t-stat H_0: β=1	[-1, +25]	t-stat H_0: β=1	[-1, +28]	t-stat H_0: β=1	[-1, +31]	t-stat H_0: β=1
$\beta_{control}$	1.01	**1.28**	1.03	**1.94**	1.04	**2.85**	1.04	**2.01**	1.06	**2.65**	1.07	**2.71**	1.07	**2.68**
Std. error	(0.01)		(0.01)		(0.02)		(0.02)		(0.02)		(0.02)		(0.03)	
β_{pilot}	0.99	**-1.15**	0.96	**-2.15**	0.98	**-1.02**	0.97	**-1.22**	0.98	**-0.63**	0.97	**-1.02**	0.96	**-1.05**
Std. error	(0.01)		(0.02)		(0.02)		(0.02)		(0.03)		(0.03)		(0.04)	
β_{pilot} - $\beta_{control}$	-0.03		-0.06		-0.06		-0.07		-0.08		-0.10		-0.11	
t-stat H_0: $\beta_{pilot} = \beta_{control}$	**-1.67**		**-2.88**		**-2.47**		**-2.19**		**-2.08**		**-2.44**		**-2.43**	

Sample period is from 2005 to 2007 (during Reg SHO). This table presents the coefficient of *RET*(*dur_announce*), β_1, for pilot and control firms from the following regression of quarterly returns -- *RET*(*quarterly*) on returns at announcements, *RET*(*dur_announce*)

$$RET(quarterly) = \beta_0 + \beta_1 RET(dur\_announce) + \varepsilon \quad (1)$$

Quarterly returns, *RET*(*quarterly*) , are buy-and-hold abnormal returns (adjusted by value-weighted market returns) over days -1 to +*t* (designated [-1, +*t*]), relative to earnings-announcement date, day 0. For brevity, I untabulte the results for two periods [-1, +19] and [-1, +22]. Earnings-announcement returns, *RET*(*dur_announce*), are 3-day buy-and-hold abnormal returns around earnings announcement. The t-statistics to test the null hypothesis: $\beta = 1$ is computed as (β-1) /Std. error. Additionally, the t-statistics to test the null hypothesis: $\beta_{pilot} = \beta_{control}$ is computed as (β_{pilot} - $\beta_{control}$)/squared root(Std. $error_{pilot}^2$ + Std. $error_{control}^2$).